T01D06 - Mass Relationships

Name KEY

Directions: In each case you **MUST**

a. Write the correctly balanced equation or balance the skeleton equation
b. Solve by means of dimensional analysis
c. Look for multiple answers, and BOX in ALL answers
d. Be NEAT and thorough.

1. Given the reaction:

lead (II) chloride + aluminium sulfate → lead (II) sulfate + aluminium chloride

① $PbCl_2$ + $Al_2(SO_4)_3$ ⟶ ① $PbSO_4$ + ② $AlCl_3$

How many grams of each product are produced when 15.5 g of lead (II) chloride reacts with an excess of aluminum sulfate?

$$15.5\,g\,PbCl_2 \times \frac{1\,mol\,PbCl_2}{278.1\,g\,PbCl_2} \times \frac{3\,mol\,PbSO_4}{3\,mol\,PbCl_2} \times \frac{303.27\,g\,PbSO_4}{1\,mol\,PbSO_4} = \boxed{16.89\,g\,PbSO_4}$$

$$15.5\,g\,PbCl_2 \times \frac{1\,mol\,PbCl_2}{278.1\,g\,PbCl_2} \times \frac{2\,mol\,AlCl_3}{3\,mol\,PbCl_2} \times \frac{133.33\,g\,AlCl_3}{1\,mol\,AlCl_3} = \boxed{4.95\,g\,AlCl_3}$$

2. Given the reaction:

$C_{24}H_{50}$ (g) + O_2 (g) → CO_2 (g) + H_2O (g) (skeleton)

② $C_{24}H_{50}$ + ⑦③ O_2 ⟶ ④⑧ CO_2 + ⑤⓪ H_2O

What mass of carbon dioxide is produced when 315.0 g of oxygen gas is used with sufficient $C_{24}H_{50}$?

$$315.0\,g\,O_2 \times \frac{1\,mol\,O_2}{32.00\,g\,O_2} \times \frac{48\,mol\,CO_2}{73\,mol\,O_2} \times \frac{44.01\,g\,CO_2}{1\,mol\,CO_2} = \boxed{284.9\,g\,CO_2}$$

What volume of water vapour is produced at STP?

$$315.0\,g\,O_2 \times \frac{1\,mol\,O_2}{32.00\,g\,O_2} \times \frac{50\,mol\,H_2O}{73\,mol\,O_2} \times \frac{22.4\,L\,H_2O}{1\,mol\,H_2O} = \boxed{151.0\,L\,H_2O}$$

3. Magnesium carbonate when heated decomposes into carbon dioxide and magnesium oxide. If 97,550 mL of carbon dioxide are produced, then how many grams of magnesium carbonate were used? How many grams of magnesium oxide are also produced? The density of carbon dioxide at these conditions is 2.25 g/L.

$$1\ MgCO_3 \longrightarrow 1\ MgO + 1\ CO_2$$

$$97{,}550\ mL\ CO_2 \times \frac{1\ L\ CO_2}{1000\ mL\ CO_2} \times \frac{2.25\ g\ CO_2}{1\ L\ CO_2} \times \frac{1\ mol\ CO_2}{44.01\ g\ CO_2} \times \frac{1\ mol\ MgCO_3}{1\ mol\ CO_2} \times \frac{84.32\ g\ MgCO_3}{1\ mol\ MgCO_3}$$

$$= 420.5\ g\ MgCO_3$$

$$= 219.5\ g\ CO_2$$

$$MgCO_3 \longrightarrow MgO + CO_2$$

$$420.5\ g \longrightarrow x + 219.5\ g \quad \Rightarrow \quad x = 201.0\ g\ MgO$$

4. Lead (II) oxide reacts with ammonia as follows: [Reaction is unbalanced]

$$3\ PbO\ (s) + 2\ NH_3\ (g) \rightarrow 3\ Pb\ (s) + N_2\ (g) + 3\ N_2O\ (l)$$

(a) How many grams of ammonia are needed to react with 8.16 grams of lead (II) oxide?

$$8.16\ g\ PbO \times \frac{1\ mol}{223.2\ g\ PbO} \times \frac{2\ mol\ NH_3}{3\ mol\ PbO} \times \frac{17.04\ g\ NH_3}{1\ mol\ NH_3} = 0.415\ g\ NH_3$$

207.2
16.

(b) How many grams of nitrogen gas are produced when 907 kg of lead (II) oxide are consumed or reacted?

$$907\ kg\ PbO \times \frac{1000\ g\ PbO}{1\ kg\ PbO} \times \frac{1\ mol\ PbO}{223.2\ g\ PbO} \times \frac{1\ mol\ N_2}{3\ mol\ PbO} \times \frac{28.02\ g\ N_2}{1\ mol\ N_2} = 38000\ g\ N_2$$

$$3.80 \times 10^4\ g\ N_2$$